

## IX.1 Safety, Codes and Standards Sub-Program Overview

### Introduction

The Safety, Codes and Standards activity assesses current practices and the status of technical standards development efforts, both nationally and internationally. It develops and implements the practices and procedures that will ensure safety in the operation, handling and use of hydrogen and hydrogen systems for all DOE-funded Hydrogen Program projects. It also facilitates the creation and adoption of model building codes and equipment standards for hydrogen systems in commercial, residential, and transportation applications. Development of codes and standards also requires coordination of activities across government agencies (i.e., Department of Transportation and state government agencies), associations, corporate stakeholders, international stakeholders, and standards and code development organizations.

The safety activity involves a large degree of external stakeholder input. Expertise is gathered from hydrogen manufacturers, the energy industry, the insurance industry, fire protection, academia, aerospace, and others to provide the widest range of perspectives on safety possible. Input is obtained through involvement in a variety of activities, as detailed under the Results section.

Communication is also a principal emphasis for maximizing impact of safety activities. All of the data and information obtained (of a non-confidential nature), and recommendations developed through activities of the Hydrogen Safety Review Panel, are made widely available through public presentations and the release of a best practices database scheduled for 2007. Training activities are undertaken at the Hazardous Materials Management and Emergency Response (HAMMER) site and are documented and made available through various media to the greatest number of recipients possible, including those that cannot travel to the HAMMER site. Planning activities supporting future activities are conducted through open workshops to ensure engagement of interested stakeholders.

### Goals

Perform the underlying research to enable codes and standards to be developed for the safe use of hydrogen in all applications. Facilitate the development and harmonization of international codes and standards.

Develop and implement the practices and procedures that will ensure safety in the operation, handling and use of hydrogen and hydrogen systems for all DOE-funded projects, and utilize these practices and lessons learned to promote the safe use of hydrogen throughout the emerging hydrogen economy.

### Objectives

- By 2007, support and facilitate the drafting of model building codes for hydrogen applications (i.e., NFPA 5000) by the National Fire Protection Association (NFPA).
- By 2006, facilitate the adoption of the International Code Council (ICC) codes in key US regions; complete R&D on hydrogen release scenarios; provide a sound basis for model code development and adoption.
- By 2007, support and facilitate the completion of International Standards Organization (ISO) standards for refueling and on-board storage and, by 2008, the completion of bulk storage standards (e.g., NFPA 55) with experimental data and input from the Technology Validation program element.

- By 2010, facilitate development of Global Technical Regulations (GTR) for H<sub>2</sub> vehicle systems under the United Nations Economic Commission for Europe, World Forum for Harmonization of Vehicle Regulations, and Working Party on Pollution and Energy Program (ECE-WP29/GRPE).
- By 2015, complete necessary codes and standards that support the commercialization of hydrogen technologies.
- By 2005, develop a comprehensive Program Safety Plan, establishing Program safety policy and guidance, and continue activities of the Safety Review Panel to provide expert guidance.
- By 2007, publish a handbook of Best Management Practices for Safety. The Handbook will be a “living” document that will provide guidance for ensuring safety in future hydrogen endeavors.
- Perform R&D to provide critical hydrogen behavior data and hydrogen sensor and leak detection technologies. This data will support the establishment of setback distances in building codes.
- Promote widespread sharing of safety-related information, procedures and lessons learned to first responders, jurisdictional authorities and other stakeholders.

### **FY 2005 Technology Status**

The expertise of the DOE Hydrogen Safety Review Panel is being used for reviewing DOE-funded projects and safety plans utilizing a panel-developed protocol. Reviews provide recommendations for safety improvements and “lessons learned” that can be of broad benefit to the DOE program. The panel, its services, and its work products are assets to funded project teams who perform their own risk assessment and mitigation planning and are responsible for their own safe operating practices. In this manner, the panel helps bring safety best practices to bear on the Hydrogen Program as a whole.

The panel completed a review of Guidance for Safety Aspects of Proposed Hydrogen Projects (August 2004 is the most recent revision), which is available on the DOE Hydrogen, Fuel Cells and Infrastructure Technologies Program website and is used as a guideline for proposal and project teams to develop safety plans to meet solicitation and/or project deliverable requirements. The guidance provides a comprehensive number of techniques that could be selected for identifying safety vulnerabilities and includes descriptive text and referenced examples.

A hydrogen training capability is being added to HAMMER, and a number of planning meetings involving DOE, HAMMER, national laboratories, and others took place in FY 2005, culminating in the first training session conducted in August. Training to be offered will include not only various testing and verification activities but also a number of “props” that offer hands-on experience for audiences such as emergency responders or permitting officials who will be asked to approve future installations of these technologies. The Safety, Codes and Standards sub-program has worked closely with the Education sub-program on this effort.

The U.S. experience with hydrogen has led to interactions with other countries wishing to learn the nation’s experience. In January 2005, a U.S. delegation traveled to China to participate in a two-day “Roadmap” workshop intended to comprise the second step in development of a Hydrogen Roadmap for China, similar to the Hydrogen Roadmap developed for the U.S. Previously, a hydrogen “Vision” workshop had been held to lay the groundwork for the Roadmap activity.

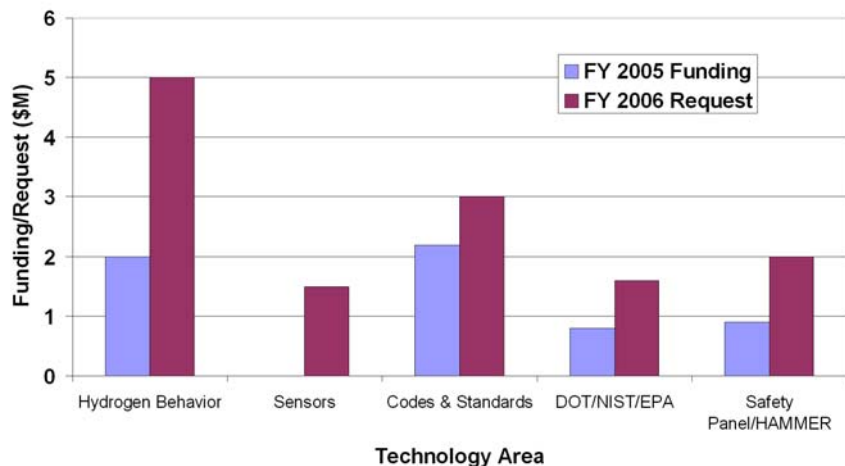
Internationally, the sub-program has been involved in a number of activities that span both codes & standards and safety. Both the International Partnership for a Hydrogen Economy (IPHE) and the International Energy Agency launched significant hydrogen safety work in 2005, each of which is supported by DOE. In addition, DOE continues to work with the Department of Transportation to support their role as U.S. representative to the UN GTR process.

## FY 2005 Accomplishments

- The DOE Hydrogen Safety Review Panel (11 members plus two direct support staff) held two panel meetings, conducted 12 site visits, and reviewed 20 safety plans.
- Completed six DOE project safety review site visits (12 total since its inception); completed 20 safety plan reviews and a hydrogen incident evaluation.
- Designed and initiated hydrogen emergency response training program at the Hazardous Materials Management and Emergency Response (HAMMER) training facility, with the first training class held in August.
- Engaged stakeholders in a Risk Assessment Workshop to identify risk assessment tools and data requirements, and to assess the viability of risk assessment work to support the code development process.
- Completed hydrogen effects on materials studies and published results on six materials classes; results are available at <http://www.ca.sandia.gov/matlsTechRef/>. An additional nine “chapters” are planned.
- Completed planning activities for R&D to support development of a hydrogen quality specification.

## Budget

Work plans for FY 2005 were significantly curtailed due to budget constraints. The budget request for FY 2006 represents increased funding for all activities, allowing the restart of hydrogen sensor R&D; hydrogen behavior, hydrogen quality and risk assessment R&D that supports the codes and standards process; and increased support for training and safety assurance.



## FY 2006 Plans

In FY 2006, the Safety Panel activity plans to conduct a total of 20-30 project reviews, including safety plan reviews for new project starts and site visits. Safety Panel expertise will be further broadened by the addition of two members. The Safety Panel will also participate in guiding the development of the Hydrogen Best Practices document to be published in 2007.

The design of training “burn props” at the HAMMER site will continue with the design of the first training aid completed; at least two classes for audiences not requiring hands-on props for training will be conducted. Continued development of first responder training curriculum for HAMMER and for use external to HAMMER activities will be sponsored by the Education sub-program, with training aids (“props”) sponsored by the Safety, Codes and Standards activity. Widespread sharing of data and information related to hydrogen safety will be continued through participation in industry meetings, publications, and compilation/documentation of safety best practices identified by the Hydrogen Safety Review Panel.

A hydrogen incident database will be initiated in FY 2006 and will be a publicly available resource which promotes hydrogen safety through publishing details of hydrogen incidents and “lessons learned.” Cooperation with the European Hysafe safety incident database is also planned, as well as coordination with

code organizations and other stakeholders. Establishment of a hydrogen incident investigation team is planned; this team will be available to investigate hydrogen incidents and report on causes and lessons learned.

In FY 2006, the Codes and Standards effort will initiate R&D to support the development of a hydrogen quality standard. Working in cooperation with the Fuel Cell sub-program, this activity will initially focus on fuel cell hydrogen quality requirements. The sub-program will continue risk assessment activities and initiate component testing work that supports risk assessment and codes & standards development.

A handwritten signature in black ink that reads "Patrick B. Davis". The signature is written in a cursive, flowing style.

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